backscattered-particle signal is subtracted from the second backscattered-particle signal to obtain a difference signal. The alignment-mark position is determined from this difference of two measured values.

The method recited in claim 1 was derived so as to solve the following problem, as described in the specification on page 3, lines 8-19 (emphasis added):

> In the apparatus of FIG. 3(A), whenever the specimen 7 is a silicon wafer having well-defined crystal properties, the BSE signal waveform that is obtained includes components derived from the alignment mark 7a and from the crystal properties of the specimen 7 itself. These signals are detected simultaneously, and thus both contribute substantially to the BSE signal waveform.
>
> For example, if the electron beam incident on a crystalline silicon wafer 7 has an energy of approximately 100 keV, then changes in signal amplitude originating from the crystalline properties of the wafer material will be nearly equal to changes in the amplitude of the BSE signal from an alignment mark formed by channels in the wafer surface. <u>The resulting lack of differentiation in the BSE signal produced by the alignment mark versus by the wafer surface causes a significant reduction in the accuracy with which the position of the alignment mark can be detected.</u>

VanVucht, in contrast, is directed to solving the following problem (col. 1, lines 40-47; emphasis added):

> In the cited Patent Specification [EP 233816] the relative position of the object with respect to the electron beam system is known. <u>A problem is encountered, however, in the case of a shift of the relative position of the object with respect to the electron beam system.</u> The invention has for its <u>object to provide an efficient method of determining a relative position of a specimen provided with a marker with respect to an electron beam system</u>.

Hence, it is clear that the method disclosed in VanVucht is directed to a different problem than the subject claims.

According to VanVucht, if a shift occurs in the location of an origin on the specimen relative to an origin of the electron-beam system, the method described in EP '816 does not work well. VanVucht solves this problem by scanning a marker pattern defined topologically or by a heavy metal on the substrate. Col. 1, line 68 to col. 2, line 13. From scanning of the marker pattern, a corresponding signal intensity distribution I(x, y) is obtained. Col. 1, lines 12-18. To

obtain an estimate of the amount of shift that has occurred in these origins relative to each other, stored data concerning an intensity distribution B(x, y) of a predetermined test pattern is recalled and compared with the measured intensity distribution I(x, y) from the marker. Col. 1, lines 35-39. The data concerning B(x, y) are assumed to be constant and are not measured from the actual specimen. Col. 2, lines 59-66 and col. 3, lines 28-36. Thus, essentially, a constant is subtracted from data obtained from an actual marker on the specimen so as to obtain data concerning differences between the two patterns (i.e., the marker pattern and the predetermined test pattern).

This method in VanVucht would not solve the problem addressed by the instant claim 1 because: (a) the data B(x, y) pertain to a predetermined test pattern, not to an area of the specimen lacking a mark; (b) the data B(x, y) that are subtracted in VanVucht are not understood to reflect changes in signal amplitude originating from the crystalline structure (or other physical property) of the substrate material itself; and (c) the data B(x, y) subtracted in VanVucht are not measured data but rather are stored data assumed to be constant.

VanVucht mentions that, "[w]hen the specimen is irradiated by an electron beam, the number of electrons dispersed by the specimen will deviate from the number of electrons dispersed by the marker. The marker can thus be distinguished from the specimen." Col. 1, lines 61-65. However, in so stating, VanVucht does <u>not</u> disclose subtracting backscattered-particle data obtained from a region of the substrate lacking an alignment mark from backscattered-particle data obtained from an alignment mark on the substrate. Rather, VanVucht is understood merely to explain that electrons dispersed by the marker are sufficiently distinctive to allow detection of those electrons.

In claim 1, data for a region of the substrate lacking a mark are subtracted from data from an actual mark. The data for the region of the substrate lacking a mark provide a background signal that, when subtracted from data obtained by backscattered charged particles from the alignment mark, removes "noise" (generated by, for example, the crystal orientation of the substrate) that otherwise would have a substantial adverse effect on the signal from the alignment mark. I.e., a backscattered-particle signal from the alignment mark has two components: one component pertains to the scattering properties of the mark itself, and the other component pertains to the physical property (notably the crystalline property) of the substrate. To separate these two components, a portion of the substrate surface lacking a mark is scanned (producing a

first signal), the mark itself is scanned (producing a second signal), and the first signal is subtracted from the second signal.

In VanVucht, in contrast, noise is removed by changing the integration time, depending upon the required accuracy of the signal. See col. 3, line 60 to col. 4, line 11. Hence, VanVucht uses an entirely different approach to reducing noise than recited in claim 1.

Furthermore, in VanVucht, the intensity of electrons dispersed from an alignment mark is measured without any attention given to the contribution, to the measured intensity, of the physical property of the substrate itself (e.g., the crystalline structure of the substrate). In claim 1, in contrast, the important contribution of charged particles backscattered from the substrate on the signal obtained by charged particles backscattered from an alignment mark on the substrate is recognized and accounted for by performing step (c) in the claim. This step is not taught or suggested in VanVucht. Also, in view of the above, VanVucht does not teach or suggest steps (a) or (d) of claim 1.

In view of the above, claim 1 and its dependents are neither anticipated by nor obvious from VanVucht.

Independent claim 6 is directed, in the context of a CPB microlithography apparatus, to a device for measuring an alignment of a substrate. The device includes a deflector situated and configured to deflect the charged particle beam to cause the beam to irradiate a predetermined location on the substrate mounted on the substrate stage, so as to cause the location to produce backscattered particles. The device also includes a backscattered-particle detector situated and configured to detect backscattered charged particles produced by the location on the substrate as the location is irradiated by the charged particle beam. The device also includes a controller connected to the deflector and the backscattered-particle detector. The controller is configured to: (1) energize the deflector in a manner causing the deflector to irradiate the beam on a first location on the substrate lacking an alignment mark, thereby producing a background backscattered-particle signal; (2) energize the deflector in a manner causing the deflector to irradiate the beam on a second location on the substrate in which an alignment mark is formed, thereby producing an alignment-mark backscattered-particle signal; (3) calculate a difference signal by subtracting the background signal from the alignment-mark signal; and (4) determine the position of the alignment mark from the difference signal.

In view of the discussion above pertaining to claim 1, VanVucht provides no teaching or suggestion of a controller, in a CPB microlithography apparatus, configured to perform items (1), (3), and (4). Simply stated, since VanVucht provides no teaching or suggestion of the method of claim 1, VanVucht cannot be shown to provide any teaching or suggestion of an apparatus having the particular combination of features recited in claim 6 specifically directed to performing the method.

Therefore, claim 6 and its dependents are neither anticipated by nor obvious from VanVucht.

In view of the foregoing, withdrawal of the rejection of claims 1-7 is appropriate and is hereby respectfully requested.

Claims 8-12 stand rejected for alleged obviousness from VanVucht. This rejection is traversed for all the reasons discussed above regarding claims 1-7 (from which claims 8-12 variously depend). In view of the allowability of claims 1-7 over VanVucht, withdrawal of the rejection of claims 8-12 is appropriate and hereby respectfully requested.

Applicant is entitled to an interview at this stage of prosecution. If, after consideration and entry of this Response, any issues concerning this application remain unresolved, the Examiner is urged to telephone the undersigned to schedule a telephone interview.

Respectfully submitted,

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